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CHEMISTRY.—*Methods of gas warfare.*[1] S. J. M. AULD, British Military Mission. (Communicated by L. J. Briggs).

All I can do in the short time available is to give you, if I can, a general idea of what gas warfare really means on the Western Front at the present time. Some of you may have gotten the idea that gas is just an incident, and that there is not as much attention being paid to it as there was two years ago. That idea is entirely wrong. Gas is used to a tremendous extent, and the amount that has been and is being hurled back and forth in shells and clouds is almost unbelievable. I will try to give you a general idea of what is occurring and make the lecture rather a popular than a technical description. I shall also, for obvious reasons, have to confine myself to describing what the Germans have been doing, and will say nothing about what we are doing.

Possibly the best plan would be to state more or less chronologically what occurred. I happened to be present at the first gas attack and saw the whole gas business from the beginning. The first attack was made in April, 1915. A deserter had come into the Ypres salient a week before the attack was made, and had told us the whole story. They were preparing to poison us with gas, and had cylinders installed in their trenches. No one believed him at all, and no notice was taken of it.

[1] Report of a lecture delivered before the Washington Academy of Sciences on January 17, 1918.

Then came the first gas attack, and the whole course of the war changed. That first attack, of course, was made against men who were entirely unprepared—absolutely unprotected. You have read quite as much about the actual attack and the battle as I could tell you, but the accounts are still remarkably meager. The fellows who could have told most about it didn't come back. The Germans have claimed that we had 6000 killed and as many taken prisoners. They left a battle field such as had never been seen before in warfare, ancient or modern, and one that has had no compeer in the whole war except on the Russian front.

What the Germans expected to accomplish by it I am not sure. Presumably they intended to win the war, and they might conceivably have won it then and there if they had foreseen the tremendous effect of the attack. It is certain that they expected no immediate retaliation, as they had provided no protection for their own men. They made a clear and unobstructed gap in the lines, which was only closed by the Canadians, who rallied on the left and advanced, in part through the gas cloud itself.

The method first used by the Germans, and retained ever since, is fairly simple, but requires great preparation beforehand. A hole is dug in the bottom of the trench close underneath the parapet, and a gas cylinder is buried in the hole. It is an ordinary cylinder, like that used for oxygen or hydrogen. It is then covered first with a quilt of moss, containing potassium carbonate solution, and then with sand bags. When the attack is to be made the sand bags and protecting cover are taken off the cylinder, and each cylinder is connected with a lead pipe which is bent over the top of the parapet. A sand bag is laid on the nozzle to prevent the back "kick" of the outrushing gas from throwing the pipe back into the trench. Our own methods are practically identical with those first used by the Germans.

The success of a cloud gas attack depends on thorough preparation beforehand. The attackers must know the country, the layout of the trenches, and the direction and velocity of the wind with certainty. Favorable conditions are limited practically to wind velocities between 12 and 4 miles an hour.

A wind of more than 12 miles an hour disperses the gas cloud very rapidly. An upward current of air is the worst foe of gas. The weight of the gas is not an important factor in carrying it along, for it mixes rapidly with air to form the moving "cloud." The time occupied by a gas attack is too short to permit of much diffusion of the gas out of the original mixture.

The gas attack must be planned very carefully. If the trench line is very irregular it is likely that gas will flow into a portion of one's own trenches. The limits of safety in wind direction are thus determined by the direction of the lines of the trenches. The Germans use a 40° angle of safety; that means that on a given straight portion of the front the wind direction must lie between the two directions which make angles of 40° with the neighboring sections of the front. The most suitable type of country is where the ground slopes gently away from where the gas is being discharged. The Germans made one mistake in believing that hilly or wooded country would not do. This was refuted by the French, who made a successful gas attack in hilly and wooded country in the Vosges, as admitted in a captured German report. If the country is flat like that about Ypres, and the wind direction is right, there is very little difficulty about making an attack, especially if the enemy does not know anything about it. The element of surprise is important.

German gas attacks are made by two Regiments of Pioneers, with highly technical officers, including engineers, meteorologists, and chemists. They brought their first cylinders into the line without our knowing anything about it, except from the deserter's report which was not believed. The element of surprise was greatly lessened when we began to know what to look for and to recognize the sounds incident to the preparation of a gas attack.

The first attack was made with chlorine. If a gas attack is to be made with gas clouds, the number of gases available is limited. The gas must be easily compressible, easily made in large quantities; and should be considerably heavier than air. If to this is added the necessity of its being very toxic and of low chemical reactivity, the choice is practically reduced to two gases: chlorine and phosgene. Chlorine is to gas warfare

what nitric acid is to high explosives. Pure chlorine did not satisfy quite all the requirements, as it is very active chemically and therefore easily absorbed. Many men in the first attack who had sufficient presence of mind saved themselves by burying their faces in the earth, or by stuffing their mufflers in their mouths and wrapping them around their faces.

There were several gas attacks of almost exactly the same kind early in 1915. There was no gas between the end of May, 1915, and December, 1915, and by that time adequate protection had been provided.

The first protection was primitive. It consisted largely of respirators made by women in England in response to an appeal by Kitchener. They were pads of cotton wool wrapped in muslin and soaked in solutions of sodium carbonate and thiosulfate; sometimes they were soaked only in water. A new type appeared almost every week. One simple type consisted of a pad of cotton waste wrapped up in muslin together with a separate wad of cotton waste. These were kept in boxes in the trenches, and on the word "gas" six or eight men would make a dive for the box, stuff some waste into their mouths, then fasten on the pad and stuff the waste into the space around the nose and mouth. But this got unpopular after a bit, when it was discovered that the same bits of waste were not always used by the same men. During the early part of 1915 this was the only protection used.

Then came the helmet made of a flannel bag soaked in thiosulfate and carbonate, with a mica window in it. A modified form of this device with different chemicals is still used in the British army as a reserve protection. It is put over the head and tucked into the jacket, and is fool-proof as long as well tucked down. This stood up very well against chlorine.

In 1915 we got word from our Intelligence Department of a striking kind. It consisted of notes of some very secret lectures given in Germany to a number of the senior officers. These lectures detailed materials to be used, and one of them was phosgene, a gas which is very insidious and difficult to protect against. We had to hurry up to find protection against it.

The outcome was a helmet saturated with sodium phenate. The concentration of gases when used in a cloud is small, and 1 to 1000 by volume is relatively very strong. The helmet easily gave protection against phosgene at a normal concentration of 1 part in 10,000. That helmet was used when the next attack came in Flanders, on the 19th of December. This attack was in many ways an entirely new departure and marked a new era in gas warfare.

There are three things that really matter in gas warfare, and these were all emphasized in the attack of December. They are: (1) increased concentration; (2) surprise in tactics; (3) the use of unexpected new materials.

Continued efforts have been made on both sides to increase the concentration. The first gas attack, in April, 1915, lasted about one and a half hours. The attack in May lasted three hours. The attack in December was over in thirty minutes. Thus, assuming the number of cylinders to be the same (one cylinder for every meter of front in which they were operating), the last attack realized just three times the concentration of the first, and six times the concentration obtained in May. Other cloud gas attacks followed, and the time was steadily reduced; the last attacks gave only ten to fifteen minutes for each discharge. We believe that the cylinders are now put in at the rate of three for every two meters of front, and may even be double banked.

The element of surprise came in an attack by night. The meteorological conditions are much better at night than during the day. The best two hours out of the twenty-four, when steady and downward currents exist, are the hour between sunset and dark and the hour between dawn and sunrise. Gas attacks have therefore been frequently made just in the gloaming or early morning, between lights. This took away one of the easy methods of spotting gas, that of seeing it, and we had to depend upon the hissing noises made by the escaping gas, and upon the sense of smell.

Another element of surprise was the sending out of more than one cloud in an attack. After the first cloud the men

would think it was all over, but ten minutes or half an hour later there would come another cloud on exactly the same front. These tactics were very successful in at least one case, namely, the attack near Hulluch in 1916. Some of the troops discarded their helmets after the first wave and were caught on the second, which was very much stronger than the first.

Efforts were also made to effect surprise by silencing the gas. But silencers reduced the rate of escape so greatly that the loss of efficiency from low concentration more than made up for the gain in suddenness. Another method was to mix the gas up with smoke, or to alternate gas and smoke, so that it would be difficult to tell where the gas began and the smoke ended.

The last attack made on the British by this means was in August, 1916. Since that time the Germans have used gas three times on the West Front against the French, and have also used it against the Italians and the Russians. It has been practically given up against the British, although the method is by no means dead.

The last attack was a slight set-back in the progress of gas defense. The casualties had been brought down to a minimum, and, as shown by the fact that the percentage of deaths was high, protection was complete in all cases where used, casualties being due to unpreparedness in some form. The attack in question was brought on under difficult conditions for the defenders, as it was made on new troops during a relief when twice as many men were in the trenches as normally. Furthermore, they had to wear helmets while carrying their complete outfit for the relief. This was the second time the Germans caught us in a relief, whether through information or luck we cannot say.

The protection that had been devised against phosgene proved effective at the time, but provision was made to meet increased concentration of phosgene. We never had any actual evidence during the attack that phosgene was being used, as no samples were actually taken from the cloud, but cylinders of phosgene were captured later. Glass vacuum tubes, about 10 by 30 cm., with a tip that could be broken off and then closed by a plasti-

cine-lined glass cap, were distributed, but the only one that came back was an unopened tube found in a hedge, and marked by the finder "Dangerous; may contain cholera germs." In a gas attack everybody keeps quiet or else has a job on hand, and conditions are not conducive to the taking of gas samples. The original types of vacuum tube were smaller than those now used.

There was a long search for materials that would absorb phosgene, as there are few substances that react readily with it. The successful suggestion came from Russia. The substance now used very extensively by all is hexamethylenetetramine (urotropine) $(CH_2)_6N_4$, which reacts very rapidly with phosgene. Used in conjunction with sodium phenate, it will protect against phosgene at a concentration of 1: 1000 for a considerable period. An excess of sodium hydroxide is used with the sodium phenate, and a valve is provided in the helmet for the escape of exhaled air. The valve was originally devised so that the hydroxide would not be too rapidly carbonated, but it was found in addition that there is a great difference in ease of breathing and comfort if a valve is placed in the mask. The helmet is put on over the head, grasped with left hand around the neck and tucked into the jacket. This form is still used in reserve.

By this time gas shells were beginning to be used in large numbers, and it became evident that protection by a fabric could not be depended on with certainty. The box type of respirator was the next development. Respirators have to fulfill two requirements which are quite opposed to one another. In the first place they should be sufficiently large and elaborate to give full protection against any concentration of any gas, whereas military exigency requires that they be light and comfortable. It is necessary to strike a balance between these two. Upon a proper balance depends the usefulness of the respirator. Oxygen apparatus will not do on account of its weight and its limited life. Two hours' life is excessive for that type. The side that can first force the other to use oxygen respirators for protection has probably won the war.

The concentrations of gas usually met with are really very low. As has been said, a high concentration for a gas cloud is

1 part in 1000, whereas concentrations of two or three per cent can be met by respirators depending on chemical reactivity. One such respirator is a box of chemicals connected by a flexible tube with a face-piece fitting around the contours of the face, and provided with a mouthpiece and nosepiece.

As regards the chemicals used there is no secret, for the Germans have many of the same things. Active absorbent charcoal is one of the main reliances, and is another suggestion that we owe to the Russians. Wood charcoal was used in one of their devices and was effective, but most of the Russian soldiers had no protection at all.

We wanted to protect against chlorine, acids and acid-forming gases, phosgene, etc., and at one time were fearful of meeting large quantities of hydrocyanic (prussic) acid (HCN). At one period every prisoner taken talked about the use of prussic acid, saying that the Kaiser had decided to end the war and had given permission to use prussic acid. Protection was evidently needed against it. The three things that then seemed most important were: (1) chlorine and phosgene; (2) prussic acid; (3) lachrymators. Charcoal and alkaline permanganate will protect against nearly everything used, even up to concentrations of ten per cent for short periods.

The German apparatus, developed about the same time, is of different pattern, and is still employed. It consists of a small drum, attached directly to the front of the face-piece, and weighs less than the British respirator but must be changed more frequently. It has no mouthpiece. The chemicals are in three layers: first an inside layer of pumice with hexamethylenetetramine, in the middle a layer of charcoal (sometimes blood charcoal), and outside baked earth soaked in potassium carbonate solution and coated with fine powdered charcoal.

As regards the future of the gas cloud, it may be looked upon as almost finished. There are so many conditions that have to be fulfilled in connection with it that its use is limited. It is very unlikely that the enemy will be able to spring another complete surprise with a gas cloud.

The case is different with gas shells. The gas shells are the most important of all methods of using gas on the Western

Front, and are still in course of development. The enemy started using them soon after the first cloud attack. He began with the celebrated "tear" shells. A concentration of one part in a million of some of these lachrymators makes the eyes water severely. The original tear shells contained almost pure xylyl bromide or benzyl bromide, made by brominating the higher fractions of coal-tar distillates.

The German did his bromination rather badly. As you know, it should be done very carefully or much dibromide is produced, which is solid and inactive. Some of the shells contained as much as 20 per cent dibromide, enough to make the liquid pasty and inactive. The shells used contain a lead lining, and have a partition across the shoulder, above which comes the T. N. T. and the fuse. These shells had little effect on the British, but one attack on the French, accompanied by a very heavy bombardment with tear shells, put them out badly. The eyes of the men were affected, and many of the men were even anesthetized by the gas, and were taken prisoner.

Our first big experience was an attack at Vermelles. The Germans put down a heavy barrage of these shells and made an infantry attack. The concentration was great, the gas went through the helmets, and the men even vomited inside their helmets. But it is difficult to put down a gas barrage, and there is danger that it will not be a technical success. In the instance cited certain roads were not cut off sufficiently, so that reinforcements got up. This attack, however, opened our eyes to the fact that, as in the case of gas clouds, concentration would be developed so as to make it high enough to produce the required effect under any circumstances.

When the Germans started using highly poisonous shells, which was at the Somme in 1916, they did not attend to this sufficiently, although enormous numbers of shell were used. The substance used was trichloromethyl-chloroformate, but not in great strength. It had no decided reaction on the eyes, hence the men were often caught.

The quantity of gas that can be sent over in shells is small. The average weight in a shell is not more than six pounds, whereas the German gas cylinders contain 40 pounds of gas. To put

over the same amount of gas as with gas clouds, say in five minutes per thousand yards of front, would require a prohibitive number of guns and shells. It becomes necessary to put the shells on definite targets, and this, fortunately, the Germans did not realize at the Somme, although they have found it out since.

The use of gas out of a projectile has a number of advantages over its use in a gas cloud. First, it is not so dependent on the wind. Again, the gunners have their ordinary job of shelling, and there is no such elaborate and unwelcome organization to put into the front trenches as is necessary for the cloud. Third, the targets are picked with all the accuracy of artillery fire. Fourth, the gas shells succeed with targets that are not accessible to high explosives or to gas clouds. Take, for instance, a field howitzer, dug into a pit with a certain amount of overhead cover for the men, who come in from behind the gun. The men are safe from splinters, and only a direct hit will put the gun out of action. But the gas will go in where the shell would not. It is certain to gas some of the men inside the emplacement. The crew of the gun must go on firing with gas masks on, and with depleted numbers. Thus it nearly puts the gun out of commission, reducing the number of shots say from two rounds a minute to a round in two minutes, and may even silence it entirely. Another example is a position on a hillside with dugouts at the back, just over the crest, or with a sunken road behind the slope. Almost absolute protection is afforded by the dugouts. The French tried three times to take such a position after preparation with high explosives, and each assault failed. Then they tried gas shells, and succeeded. The gas flows rapidly into such a dugout, especially if it has two or more doors.

Among the effective materials used by the Germans for gas shells were mono- and tri-chloromethyl-chloroformate. Prussic acid never appeared; the Germans rate it lower than phosgene in toxicity, and the reports concerning it were obviously meant merely to produce fear and distract the provisions for protection.

During the last five months the actual materials and the tactics used by the Germans have undergone a complete change.

The lachrymator shells are less depended upon than formerly for "neutralization," but are still a source of annoyance. Mere annoyance, however, may be an effective method of neutralizing infantry. For instance, where large amounts of supplies and ammunition are being brought up there are always cross-roads where there is confusion and interference of traffic. A few gas shells placed there make every man put on his mask, and if it is a dark night and the roads are muddy the resulting confusion can be only faintly imagined. It may thus be possible to neutralize a part of the infantry by cutting down their supplies and ammunition.

The use of a gas shell to force a man to put on his mask is practically neutralization. If at the same time you can hurt him, so much the better. Hence the change in gas-shell tactics, which consists in replacing the purely lachrymatory substance by one that is also poisonous.

One substance used for this method of simultaneously harassing and seriously injuring was dichloro-diethylsulfide (mustard gas). Its use was begun in July of last year at Ypres, and it was largely used again at Nieuport and Armentieres. A heavy bombardment of mustard-gas shells of all calibers was put on these towns, as many as 50,000 shells being fired in one night. The effects of mustard gas are those of a "super-lachrymator." It has a distinctive smell, rather like garlic than mustard. It has no immediate effect on the eyes, beyond a slight irritation. After several hours the eyes begin to swell and inflame and practically blister, causing intense pain, the nose discharges freely, and severe coughing and even vomiting ensue. Direct contact with the spray causes severe blistering of the skin, and the concentrated vapor penetrates through the clothing. The respirators of course do not protect against this blistering. The cases that went to the hospitals, however, were generally eye or lung cases, and blistering alone took back very few men. Many casualties were caused by the habit that some of the men had fallen into of letting the upper part of the mask hang down so as not to interfere with seeing. The Germans scored heavily in the use of this gas at first. It was another example of the

element of surprise in using a new substance that produces new and unusual symptoms in the victims.

Up to the present time there has been no material brought out on either side that can be depended on to go through the other fellow's respirator. The casualties are due to surprise or to lack of training in the use of masks. The mask must be put on and adjusted within six seconds, which requires a considerable amount of preliminary training, if it is to be done under field conditions.

Among other surprises on the part of the Germans were phenylcarbylamine chloride, a lachrymator, and diphenylchloroarsine, or "sneezing gas." The latter is mixed in with high explosive shells or with other gas shells, or with shrapnel. It was intended to make a man sneeze so badly that when he puts on his mask he is not able to keep it on. The sneezing gas has, however, not been a very great success.

All bombardments now are of this mixed character. The shells used are marked with differently colored crosses, and definite programs are laid down for the use of the artillerymen.

As regards the future of gas shells, it should be emphasized that the "gas shell" is not necessarily a gas shell at all, but a liquid or solid shell, and it opens up the whole sphere of organic chemistry to be drawn upon for materials. The material placed inside the shell is transformed into vapor or fine droplets by the explosion and a proper adjustment between the bursting charge and the poisonous substance is necessary. Both sides are busy trying to find something that the others have not used, and both are trying to find a "colorless, odorless, and invisible" gas that is highly poisonous. It is within the realm of possibilities that the war will be finished, literally, in the chemical laboratory.

The Germans have not altered their type of respirator for some time, and it is not now equal in efficiency to the British or American respirator. The German respirator, even in its latest form, will break down at a concentration of 0.3 per cent of certain substances. The German design has given more weight to military exigency, as against perfect protection, than has the

British. Another thing that weighs against changes in design is the fact that the German, already handicapped by the lack of certain materials, must manufacture 40,000,000 respirators a year in order to supply his Austrian, Bulgarian, and Turkish allies, as well as his own army.

In the British and American armies the respirator must always be carried with the equipment when within 12 miles of the front. Between 12 and 5 miles a man may remove the respirator box in order to sleep, but within 5 miles he must wear it constantly. Within 2 miles it must be worn constantly in the "alert" position (slung and tied in front). When the alarm is given he must get the respirator on within six seconds. The American respirator is identical with the British. The French have a fabric mask made in several layers, the inner provided with a nickel salt to stop HCN, then a layer with hexamethylenetetramine; it has no valve and is hot to wear. The French also use a box respirator, consisting of a metal box slung on the back, with a tube connecting to the face mask; the latter is of good Para rubber and is provided with a valve. One disadvantage of this form is the danger of tearing the single rubber sheet. The German mask now contains no rubber except one washer; the elastics consist of springs inside a fabric, and the mask itself is of leather. It hardens and cracks after being wet, and is too dependent upon being well fitted to the face when made.

(The lecturer exhibited various types of gas shells, helmets, masks, and respirators.)

The following compounds have been used by the Germans in gas clouds or in shells:

1. Allyl-iso-thiocyanate (Allyl mustard oil), C_3H_5NCS (shell).
2. Benzyl bromide, $C_6H_5CH_2Br$ (shell).
3. Bromo-acetone, $CH_2Br.CO.CH_3$ (hand grenades).
4. Bromated methyl-ethyl-ketone (bromo-ketone), CH_2Br-COC_2H_5 or $CH_3.CO.CHBr.CH_3$ (shell). Dibromo-ketone, CH_3-$COCHBr.CH_2Br$ (shell).
5. Bromine, Br_2 (hand grenades).
6. Chloro-acetone, $CH_2Cl.COCH_3$ (hand grenades).
7. Chlorine, Cl_2 (cloud).

8. Chloromethyl-chloroformate (Palite), $ClCOOCH_2Cl$ (shell).

9. Nitro-trichloro-methane (Chloropicrin or nitrochloroform), CCl_3NO_2 (shell).

10. Chlorosulfonic acid, $SO_3.H.Cl$ (hand grenades and "smoke pots").

11. Dichloro-diethylsulfide (mustard gas), $(CH_2ClCH_2)_2S$ (shell).

12. Dimethyl sulfate, $(CH_3)_2SO_4$ (hand grenades).

13. Diphenyl-chloro-arsine, $(C_6H_5)_2AsCl$ (shell).

14. Dichloromethyl ether, $(CH_2Cl)_2O$ (shell).

15. Methyl-chlorosulfonate, CH_3ClSO_2 (hand grenades).

16. Phenyl-carbylamine chloride, $C_6H_5NCCl_2$ (shell).

17. Phosgene (carbonyl chloride), $COCl_2$ (cloud and shell).

18. Sulfur trioxide, SO_3 (hand grenades and shell).

19. Trichloromethyl-chloroformate (Diphosgene, superpalite), $ClCOOCCl_3$ (shell).

20. Xylyl bromide (tolyl bromide), $CH_4C_6H_4CH_2Br$. (shell).

BOTANY.—*Blepharidium, a new genus of Rubiaceae from Guatemala.*[1] PAUL C. STANDLEY, U. S. National Museum.

In the U. S. National Herbarium there are specimens of a striking rubiaceous plant, hitherto undescribed, collected in Guatemala by Mr. Henry Pittier. Some years ago this material was examined by Captain John Donnell Smith, who concluded that it probably represents an undescribed genus. Recently, while preparing an account of the Rubiaceae for the North American Flora, the writer has studied the material and has arrived at the same conclusion. Among North American representatives of the family the plant is noteworthy because of its large, long-petiolate leaves and of its large flowers, borne in peculiar 3-flowered cymes. Its general appearance does not definitely associate it with any of the known genera, and its floral details are such as to necessitate its recognition as a new genus, for which the name *Blepharidium* is here proposed.

[1] Published by permission of the Secretary of the Smithsonian Institution.

Blepharidium Standley, gen. nov.

Shrubs or trees, with subterete branchlets. Leaves opposite, petiolate, the blades large, chartaceous. Stipules intrapetiolar, large, thin, acuminate, entire, caducous. Flowers large, pedicellate, bibracteolate, in 3-flowered cymes, the cymes axillary, long-pedunculate; calyx-tube obovoid, the limb large, prolonged beyond the ovary, 4-lobate, the lobes very broad, imbricate, ciliolate; corolla salverform, coriaceous, the tube slender, elongate, densely villous within except near the base, the limb 4-lobate, the lobes broad, spreading, imbricate in bud, one of them exterior. Stamens 4, inserted in the throat of the corolla; anthers sessile, dorsifixed below the middle, linear, obtuse, included. Disk annular. Ovary 2-celled; style filiform, included, the stigma bilobate, the lobes linear, elongate, acute; ovules numerous, imbricate, winged, the placentae attached to the septum.

Type species, *Blepharidium guatemalense* Standley.

Blepharidium guatemalense Standley, sp. nov.

Branchlets stout, green, glabrous, sparsely whitish-lenticellate, the internodes elongate; stipules ovate-triangular, 2–2.5 cm. long, acuminate or cuspidate-acuminate, brown, glabrous outside, within sericeous-pilose at the base and bearing numerous glands; petioles stout, 2.5–5 cm. long, glabrous; leaf-blades oval-oblong, 17–30 cm. long, 8–14.5 cm. wide, obtuse or acute at the base, obtuse or acute at the apex, concolorous, glabrous above, the costa impressed, the other venation prominulous, sparsely short-pilose beneath along the prominent costa, the lateral veins prominent, about 8 on each side, arcuate-ascending; peduncles 3-flowered, slender, 7–21 cm. long, glabrous, the pedicels stout, 0.3–2 cm. long; bracts foliaceous, oval, about 1 cm. long, the bractlets broadly ovate, 3–4 mm. long, deciduous; calyx glabrous, the tube 4–5 mm. long, the limb 4–5 mm. long, 7–8 mm. broad, the lobes half as long as the tube, broader than long, rounded or truncate, minutely ciliolate; corolla-tube about 6 cm. long, 4–5 mm. thick, glabrous outside, the lobes oval, about 1 cm. long; anthers 7 mm. long; stigma-lobes 6–7 mm. long.

Type in the U. S. National Herbarium, no. 472925, collected in forest along Saklak River, below Secanquím, Alta Verapaz, Guatemala, altitude 300 meters, May 7, 1905, by Henry Pittier (no. 266).

Blepharidium is evidently a member of the Cinchoneae, for although mature fruit, upon which the classification of the Rubiaceae is chiefly based, is not available for study, the large, imbricate, winged ovules are characteristic of this tribe alone. Within the tribe, however, it is not easy to determine the exact position of the genus. In most published keys to the subgroup, it would fall near *Exostema*, but it does not appear to be very

closely allied to that genus, in which the anthers are borne on long filaments. By the sessile anthers *Blepharidium* is easily distinguished from all the genera of the Cinchoneae with imbricate corolla lobes.

ZOOLOGY.—*A key to the Philippine subspecies of* Obba marginata *with notes on their distribution.*[1] PAUL BARTSCH, U. S. National Museum.

The preparation of a report on the Philippine Island land shells reveals so many distributional gaps in the material available for study that it seems wise to publish a series of synopses in the form of keys to the various groups as the work progresses, together with a brief account of the zoogeographic facts presented by the data at hand

It is hoped that these sketches may serve to stimulate collectors to bestow their efforts upon localities from which material is sadly needed to render the monographic reports complete.

OBBA MARGINATA Müller

In this species the shell varies from broadly conic (*Obba marginata mearnsi*), to almost lenticular (*Obba marginata samarensis*). The range in size is also great. *Obba marginata saranganica* attains a greater diameter of 35 mm., while in *Obba marginata mearnsi* it does not exceed 19 mm. All the races have a narrow acute peripheral keel to which the summit of the succeeding turn is appressed. The ground color varies from pale buff (*Obba marginata griseola* and *Obba marginata mearnsi*), to pale brownish (*Obba marginata marginata*). In all the subspecies known, the peripheral keel and the extreme summit are edged by a very narrow white or whitish zone, while the rest of the upper surface of the turns is marked by three bands of brown of which one adjoins the peripheral white zone while another bounds the white line at the summit and the third occupies a space almost midway between them. The width of these brown bands varies in the different races. In some they equal the light areas that separate them (*Obba marginata balutensis*), while in others some of them are represented by mere hair lines. The intensity of the color may be the same or may vary in the different bands on the same whorl, the band at the summit being usually much paler than the rest. Two bands are present on the basal sides of all the members of this species, one adjoin-

[1] Published by permission of the Secretary of the Smithsonian Institution.

ing the light peripheral zone and another situated at about one-third of the distance between the periphery and the umbilicus anterior to the periphery. Here, as in the banding of the upper surface, we find a considerable variation both as to intensity of coloration and width of the band. In some the zone at the periphery is merely indicated (*Obba marginata lanaona* and *Obba marginata mearnsi*), while in others they are very dark and broad (*Obba marginata marginata* and *Obba marginata balutensis*). In all the forms the basal lip is toothless. Under the microscope we find that the first half turn is smooth; the turn and a half following this are marked by slender oblique, retractively curved, axial threads, best seen near the summit and at the periphery; while the succeeding turns have in addition to these threads, very fine, closely spaced, impressed lines which cross each other more or less at right angles and the lines of growth at an angle of about 45° and give the surface a fine cloth-like texture.

The various subspecies of *Obba marginata* can readily be divided into two groups, one in which the dark coloration predominates over the light zones and another in which the reverse is true. To the first of these, the dark group, belong the subspecies *saranganica*, *balutensis*, *marginata*, *worcesteri*, and *boholensis*. In the light group we find characters that readily enable one to further subdivide it. In two forms (*mearnsi* and *palmasensis*) the shell is broadly conic. In the rest the shell is lenticular. This last complex is again divisible. One part (subspecies *griseola*, *samarensis*, *pallescens*, and *nana*) has the basal peripheral band well developed. In the other (subspecies *zamboanga*, *lanaona*, and *joloensis*) the basal peripheral band is obsolete.

The distribution, as known to date, extends from the central islands of Samar, Leyte, Bohol, and Cebu, southward over Mindanao to Jolo on the west and Sarangani and Palmas islands on the east in the Philippines, and still farther south beyond our range at least to Celebes. A plotting of the known distribution points strongly to the fact that many additional subspecies may be expected when more careful and extensive collecting shall have been done. The species should occur on the islands between Samar, Leyte, and Mindanao. In Mindanao itself we know it only from the northern coastal strip and Zamboanga and it scarcely stands to reason that there should be a gap in the distribution between the north coast and the little islands of Sarangani, Balut, Olanivan, and Palmas off the southeast coast where it is well represented.

The distribution of the groups outlined above is rather interesting. The subspecies in which the dark coloration predominates are known from Bohol, Camiguin, north of Mindanao and the islands of Olanivan, Sarangani, and Balut off southeastern Mindanao. None of the dark forms so far are known from the large island of Mindanao itself. The broadly conic light-colored *Obba marginata mearnsi* and *Obba marginata palmasensis* come from Sarangani and Palmas, respectively, both off southeastern Mindanao. The light colored lenticular forms having the basal peripheral color band well developed are so far known from Samar, Leyte, Cebu, and northeastern Mindanao, and I strongly suspect that the form recorded from Siquijor and that from Talisayan, Mindanao, will prove to belong here. The light-colored lenticular forms in which the basal peripheral band is obsolete are known from western Mindanao and the island of Jolo.

The following key may be of help in determining the known subspecies[1]:

Dark bands predominating over the light zones.
  Greater diameter more than 30 mm.
    Lines of growth strongly developed (Sarangani Island). **saranganica** Hidalgo.
    Lines of growth not strongly developed (Balut Island). **balutensis** new.
  Greater diameter less than 30 mm.
    Basal bands very dark brown.
      Greater diameter more than 25 mm. (Camiguin Island). **marginata** Müller.
      Greater diameter less than 22 mm. (Olanivan Island). **worcesteri** Bartsch.
    Basal bands light brown (Bohol Island)..... **boholensis** new.
Dark bands not predominating over the light zones.
  Light zones much greater than the dark.
    Shell broadly conic.
      Peripheral basal color band moderately strong (Palmas Island)..... **palmasensis** new.
      Peripheral basal color band obsolete (Sarangani Island). **mearnsi** new.
    Shell not broadly conic, lenticular.
      Peripheral basal brown band obsolete.
        Median band above and below reddish (Zamboanga, Mindanao)..... **zamboanga** new.

[1] The types of the new subspecies are registered in the U. S. National Museum under the following numbers: *balutensis*, no. 256548; *boholensis*, no. 116914; *palmasensis*, no. 256420; *mearnsi*, no. 256423; *lanaona*, no. 256495; *joloensis*, no. 256549; *samarensis*, no. 256549.

Median band above and below not reddish, all bands brown.
Base very strongly convex (Lanao Province, Mindanao).....**lanaona** new.
Base very slightly convex (Jolo Island).
joloensis new.
Peripheral basal brown band not obsolete.
Greater diameter more than 23 mm.
Band near the summit and at the periphery more or less interrupted (Cebu Island).
griseola Möllendorff.
Band at the summit and near the periphery not interrupted (Samar Island).
samarensis new.
Greater diameter less than 21 mm.
Peripheral basal band strong (Leyte Island).
pallescens Möllendorff.
Peripheral basal band not strong (Northeast Mindanao).....**nana** Möllendorff.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this JOURNAL and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

GEOLOGY.—*Geology of the Navajo country. A reconnaissance of parts of Arizona, New Mexico, and Utah.* HERBERT E. GREGORY. U. S. Geological Survey Professional Paper 93. Pp. 161, with maps, sections, and illustrations. 1917.

The region bordering the Colorado canyons between Little Colorado and San Juan rivers and extending southward to the line of the Atchison, Topeka & Santa Fe Railway is described. The primary object of the investigations was to "spy out the land," with a view to suggesting ways in which the country could be more fully utilized. The region is arid, and the geologic field work was therefore designed chiefly to obtain information concerning the water supply.

The Navajo country is part of the Colorado Plateau province, a region of folded and faulted sedimentary rocks traversed by innumerable canyons. The consolidated sedimentary rocks exposed in the Navajo country are chiefly of Mesozoic age—Triassic, Jurassic, and Cretaceous. The predominant rock of the whole Navajo country is sandstone of medium grain; limestone and conglomerate are much less common, and typical clay shale is rare.

In the Grand Canyon district the dominating structural features are represented topographically by flat-topped plateaus, bordered by lines of displacement trending roughly north. The simplicity of folded structures in the Grand Canyon district is not, however, duplicated in the region east of Colorado River. Synclines and anticlines, both broad and narrow, sharply delineated monoclines, and domical upwarps follow one another in succession or abut against one another like waves in a choppy sea. In one feature only—their general trend—do the flexures displayed in the Navajo country simulate those of the region farther west. Ten major folds and eight minor folds, in addi-

tion to local flexures of small dimensions, were noted in the region between the San Juan and the Puerco and Little Colorado.

The physiographic history of the Navajo country is included in that of the Colorado Plateau. The stratigraphic series of the area is essentially that of the Grand Canyon district; the crustal movements of the two areas, though different in kind, were probably contemporaneous, and it is reasonable to suppose also that the periods of igneous activity for the whole Plateau province are closely related in time.

The surface of the Navajo country has been carved rather than built; features resulting from deposition are relatively unimportant. Talus slopes and alluvial fans are replaced by cliffs; hills and knolls give way to buttes and towers; and graded slopes are represented by walls sculptured into rincons, recesses, alcoves, niches, windows, and arches, of large variety.

Wide, open mouths of niches and caves perched high on the canyon walls are conspicuous. These cavities, protected from rain, from the glaring heat of the sun, and from the suffocating sandstorms, were widely utilized by the ancient inhabitants as building sites—"rock shelters" or "cavate dwellings."

Perhaps the most striking erosion feature within the Navajo country is the recently discovered Rainbow Bridge, which spans Bridge Canyon, on the northwest slope of Navajo Mountain. Its symmetry and graceful proportions, as well as its size and beauty of color, give to this arch a commanding position among the natural bridges of the world. R. W. STONE.

GEOLOGY.—*Ground water for irrigation in Lodgepole Valley, Wyoming and Nebraska.* OSCAR E. MEINZER. U. S. Geological Survey Water-Supply Paper 400-B. Pp. 33, with 4 maps. 1917.

This brief report discusses the distribution and water-bearing character of the Ogalalla and Arikaree formations, the Brule clay, the underlying formations, and the Quaternary stream gravels. Large yields are obtained in the valley from the stream gravels and from the underlying jointed portions of the Brule clay. The strongest well yielded, in a test of one hour, at the rate of 710 gallons per minute with a drawdown of less than 4 inches. The report describes the natural processes of storage of water in the underground reservoir and of discharge therefrom by gravity in the irrigation season. It also gives data by the author and by Mr. H. C. Diesem, of the Department of Agriculture, on the cost of pumping for irrigation. O. E. M.

PETROLOGY.—*Chemical analyses of igneous rocks published from 1884 to 1913, inclusive.* H. S. WASHINGTON. U. S. Geological Survey Professional Paper 99. Pp. 1201, with 3 figures. 1917.

This paper is a revision and expansion of Professional Paper 14, published in 1903. In the introductory text the characters of rock analyses are discussed under the heads of representativeness of the sample analyzed and the accuracy and completeness of the analysis. The chief errors, both of commission and omission, to which rock analyses are liable are described, and the scheme for rating analyses as to their quality, adopted in the work, is explained.

It has been the aim to make the present collection as complete and accurate as possible and, in a sense, definitive. The search through the literature, a list of the publications examined being given, has been very extensive, and in this the library of the U. S. Geological Survey has been the main reliance. The number of analyses collected in the tables amounts to 8602, as against 2881 in the previous collection, which analyses are included in the present work. A great improvement in quality over the earlier work is manifest. The tables, which occupy 1098 pages, are divided into four parts: superior analyses of fresh rocks; incomplete but otherwise superior analyses of fresh rocks; superior analyses of altered rocks and tuffs; and inferior analyses. The analyses in Part I are arranged according to the Quantitative Classification and the norm of each, every one of which has been recalculated, is given. A discussion of the rules for naming and of some of the names of this system is to be found in the text.

In appendixes are presented a description of the Quantitative Classification, with a tabular presentation of its divisions and names, a description of the method of calculating the norm, as well as the tables for the calculation of the molecular numbers of the chemical components and percentages of mineral molecules. H. S. W.

PARASITOLOGY.—*Recent progress in the development of methods for the control and treatment of parasites of live stock.* B. H. RANSOM. Proc. Second Pan-Amer. Sci. Congr. **3**: 709–718. 1917.

Brief review with list of references. B. H. R.

PARASITOLOGY.—*The sheep tick and its eradication by dipping.* MARION IMES. U. S. Dept. Agr. Farmers' Bulletin 798, 31 pp., figs. 1–15. May, 1917.

A popular discussion with details of methods of control and eradication. B. H. Ransom.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

WASHINGTON ACADEMY OF SCIENCES

The 118th meeting of the Academy, the twentieth Annual Meeting, was held in the Assembly Room of the Cosmos Club the evening of Tuesday, January 8, 1918, with President W. H. HOLMES in the chair. The minutes of the last Annual Meeting were read and approved.

The Corresponding Secretary, Dr. R. B. SOSMAN, elected by the Board of Managers in September, 1917, to fill the unexpired term of Dr. F. E. WRIGHT, on account of the latter's continued absence from the city while engaged upon war work, reported that on January 1, 1918, the membership consisted of 6 honorary members, 4 patrons, and 470 members, one of whom was a life member. The total membership was 480, of whom 283 reside in or near the District of Columbia. During the year 1917 the Academy has lost by death: WILLIAM BULLOCK CLARK, July 27, 1917; RICHARD BRYANT DOLE, January 21, 1917; ARNOLD HAGUE, May 13, 1917. Reference was made also to the distribution of a new edition of the "red book," the Directory of the Washington Academy of Sciences and affiliated Societies, in July.

The Recording Secretary reported that four public lectures had been held during the past year, including the three on Heredity, as reported upon in the JOURNAL of the Academy for January 4, 1918.

In the absence of the Treasurer, Mr. WILLIAM BOWIE, his report was read by the Secretary. The report showed a balance of $850.93 on January 1, 1917, receipts totaling $6442.69 during the year (including the payment of a note for $2000,) disbursements totaling $4308.81 (including the purchase of a Liberty Loan Bond for $500), and a balance on December 31, 1917, of $2984.81. The Auditing Committee, consisting of Messrs. E. F. MUELLER, H. G. FERGUSON, and H. D. GIBBS, reported that the report of the Treasurer agreed in all respects with the accounts and with the securities on deposit.

Dr. N. E. DORSEY read the report of the Board of Editors.

The report of the tellers, Messrs. J. F. MEYER, H. E. MERWIN, and R. B. SOSMAN, was read by the Corresponding Secretary. The tellers reported that the mail ballot had resulted in the election of the following officers for 1918: *President*, L. J. BRIGGS; *Corresponding Secretary*, R. B. SOSMAN; *Recording Secretary*, WILLIAM R. MAXON; *Treasurer*, WILLIAM BOWIE; *Non-resident Vice-Presidents*, T. A. JAGGAR, JR., and B. L. ROBINSON; *Members of Board of Managers, Class of* 1921, T. H. KEARNEY and A. C. SPENCER.

The following resident Vice-Presidents, nominated by the affiliated societies, were then elected: *Anthropological Society*, JOHN R. SWANTON; *Archaeological Society*, ALEŠ HRDLIČKA; *Biological Society*, J. N. ROSE; *Botanical Society*, T. H. KEARNEY; *Chemical Society*, FREDE-

RICK B. POWER; *Society of Engineers*, EDWIN F. WENDT; *Electrical Engineers*, P. G. AGNEW; *Society of Foresters*, RAPHAEL ZON; *Geological Society*, W. C. MENDENHALL; *Historical Society*, ALLEN C. CLARK; *Medical Society*, PHILIP S. ROY; *Philosophical Society*, GEORGE K. BURGESS.

The Entomological Society and the National Geographic Society had nominated no Vice-Presidents.

The following amendments to the By-Laws of the Academy, designed to avoid the existing conflict of dates between the annual meeting of the Academy and the regular meeting of the Chemical Society, were then read and, in accordance with the By-Laws, referred to the Board of Managers:

(1) In Section 1, Article III, substitute "Tuesday" for "Thursday." The section will then begin as follows: "The Annual Meeting shall be held each year on the second Tuesday of January."

(2) In Section 1 of Article V substitute "Tuesday" for "Thursday."

The retiring President, Dr. HOLMES, delivered an address entitled *Man's place in the Cosmos as shadowed forth by modern science*, the newly elected President, Dr. L. J. BRIGGS, presiding.

"The address was designed to give a brief but comprehensive view of the career of man not in the world simply, but to shadow forth his place in the cosmos of which he was formerly thought to be the central feature. The problems of the immediate past are in part readily solved, while the remote past fades into the impenetrable shadows of the infinite. The problems of the present appear large in the foreground, so that he who runs may read; but the problems of the future find their solutions shrouded in the mists of the unknown and the unknowable.

"The story of the progress of research from the childish romancings of the savage mind through quagmires of superstitious interpretations to the astonishing revelations of modern science is a fascinating chapter in human history. The origin of the earth is found in the reassembling and consolidation of the widely disseminated matter of a spiral nebula, a process believed to be responsible for the evolution of the solar system as a whole—the sun and its attendant bodies. These nebulæ, of which a thousand have been identified, are thought to be due to the encounter of heavenly bodies with such force as to distribute their component particles widely throughout space, the encounters being due to the eccentricity of the orbits.

"The earth thus gathered together by the forces of gravity from the dust of ruined spheres became, after ages of ripening, the seat of life,—an oasis in the vast desert of the cosmos. The story of the beginnings and evolution of living things has been preserved in the fossil-bearing strata of the earth's surface and its outlines are well made out. From the earliest, exceedingly simple and minute forms advance was made throughout several stages of specialization to the culmination in man, each stage requiring millions of years in its accomplishment. But the story is not ended. Mobility, unceasing change is the rule of the universe. That which grows or develops reaches its meridian and passes

into other forms. The fate of the human race is wrapped up with the fate of the minute satellite which we call the earth, and is subject to the ever active mobilizing forces of the cosmos. It must be molded and remolded into other worlds and suns and stars forever.

"But there are other wonders. The atoms which now enter into the constitution of all things—our bodies, the world, and the universe,—are indestructible. They have existed always and will continue to eternity. The millions of atoms which now form a drop of human blood, for example, have each a history more marvelous than words can tell or mind conceive, each having passed through changes without beginning and must continue to pass through other changes without end.

"At a certain stage in the earth's evolution life was generated and there is no reason why a million worlds may not have reached a corresponding stage—the stage at which the elements and the energies acting under immutable laws necessarily bring about the particular phenomenon known as life. But in the transformations of worlds these phenomena of life can be but negligible incidents, and the human race which we see so large is with all the other attendant phenomena of life in the world, and in all worlds for that matter, only as a breath in the unending cataclysms of the incomprehensible cosmos.

"If any part of the story of man's place in the universe thus outlined should be challenged, and many parts are open to challenge, the challenger may be assured that, if the present interpretations of science are wrong in whole or in part, the story which will finally be told, or which may never be told, must be more marvelous than this or any other that the human mind has conceived."

The 119th meeting of the Academy was held in the Assembly Room of the Cosmos Club the evening of Thursday, January 17, 1918, the occasion being the first of a series of illustrated lectures dealing with Science in Relation to the War. The speaker, Maj. S. J. M. AULD, of the British Military Mission, delivered an address on the subject *Methods of gas warfare*. A summary of the lecture will be found elsewhere in this number of the JOURNAL (pp. 45–58).

WILLIAM R. MAXON, *Recording Secretary*.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 517th meeting of the Society was held in the Auditorium of the U. S. National Museum on Tuesday, December 4, 1917, at 4.30 p.m. At this meeting Dr. AMANDUS JOHNSON, of the University of Pennsylvania, addressed the society on *The Scandinavian peoples*, illustrating his address with lantern slides.

The Scandinavian Peninsula has undoubtedly been inhabited by its present occupants for 10,000 years or more. When the climate of the country became tolerable after the vast icefields receded, tribes of the Aryan race found their way into southern Sweden, and established there the original home of the Germanic peoples. About the year 3000 B.C.,

at the end of the Stone Age, considerable advancement in culture had been made, and during the Bronze Age the decorative instinct of the people found expression in works of art unsurpassed elsewhere in Europe at that period. Later the Hallstatt and La Tène civilizations made their influence felt and finally, about the beginning of the Christian Era, Roman culture became the predominant foreign influence. An extensive trade developed with the western world during the following centuries, and many remains of this intercourse are found in Sweden and Denmark.

The most important period historically is the so-called Viking Age, 800–1000 A.D. Wonderful progress had been made in shipping and navigation. Fleets of the Viking ships appeared on almost every shore. The bold sailors sacked cities on the Mediterranean and Black Seas, ruled Ireland for generations, and conquered parts of France, England, and Spain; they founded Russia, and settled colonies in America and numerous other places. Finally Christianity was introduced and the Scandinavians settled down to a life of peaceful toil. The mental and spiritual reaction following the Viking expeditions was intense. A prose literature grew up, especially in Ireland. This was the most remarkable in Europe at the time and was the only original prose of the Germanic race. With it was coupled a poetry no less important. This art died, however, at about the time when distinct Scandinavian nationalities began to develop, and from the twelfth century onward we find long stretches of time nearly void of mental activity.

From this period Sweden began to lead a more separate life, but Denmark and Norway were gradually drawn closer together until the latter country nearly lost its identity. Denmark was the leading power of the north until the appearance of Gustavus Adolphus. Then Sweden acquired the supremacy. Through the supreme ability of her leaders she changed the course of European history and for more than a century played the rôle of a great power. In modern times Sweden has produced leading scientists, created a rich literature, and developed large industrial establishments.

After 1644 Denmark was weakened from time to time by the curtailment of her territory until in 1864 she was reduced to her present area. In the fields of science, letters, and art, however, she can point to brilliant achievements. Norway paid the price of dependency for many generations, and not until her separation from Denmark can we speak of a worthy Norwegian literature. But in the last century the leadership of the drama belongs to her, and in many lines of achievement some of her names rank among the first.

The 518th meeting of the Society was held in the Lecture Hall of the Public Library, on Tuesday, December 18, 1917, at 8 p.m. On this occasion Dr. DANIEL FOLKMAR, U. S. Tariff Commission, delivered a lecture on *Japan: people and policies*, illustrated by numerous lantern slides.

Dr. Folkmar opened his address by asking "Who are the Japanese? Are they as closely related to the Chinese as many Americans think, or

are they a very different race, as the Japanese themselves think? The whole attitude of the Japanese toward the Chinese and toward the American people seems to rest on the assumption that they are not Mongolian, strictly speaking, and that they should be treated as our equals."

The Japanese frequently compare their empire with England, the Island Empire which rules a great part of the world from its favored position in the Atlantic, a position similar to that of Japan in the Pacific Ocean. The Japanese are unquestionably a mixed race, like the English and most of the leading nations of the present day. Five distinct ethnic types are to be found among the Japanese. The most important is the Manchu-Korean type, taller than the others and seen chiefly among the upper classes. The second is the well-known Mongolian type, with a broader face. Perhaps the most important element in the present nationality is the Malay strain, whose representatives are small in stature. The Ainu preceded both Mongolians and Malays, and it now appears that they, in turn, were preceded by a smaller race of pit-dwellers. According to Keane the Japanese bear a physical resemblance to the Mongolians, but linguistically are more closely related to the northern Asiatic Finno-Tataric stock. From this point of view the Japanese are more closely related to the Koreans than to the Chinese, since the Korean language is agglutinative and that of the Chinese is monosyllabic. Numerous authorities were cited on this and similar problems of the Japanese people. Japan received its profound philosophies from India and China. Thus the native religion of Japan is Shintoism, together with Buddhistic beliefs that came from India, and Confucianism from China.

Concerning Japanese policies Dr. Folkmar said, "There is no doubt that an exclusive policy dominated the national policies of Japan until Perry, the American, broke down the barriers. This act is now regarded by the leaders and educated classes as one of the most fortunate events in their national history." Dr. Folkmar spoke in high encomium of the manner in which the Japanese Empire has kept its word in restricting the emigration of Japanese to the United States, and said that there can be no doubt of the wisdom of taking the Japanese at their word in the recent convention that has been signed regarding the "open door policy."

The 519th meeting of the Society was held in the West Study Room of the Public Library, January 15, 1918, at 8 p.m. The program consisted of a general discussion of War Anthropology, led by Dr. ALEŠ HRDLIČKA, Curator, Division of Physical Anthropology, U. S. National Museum.

Taking as his subject *War and Race*, Dr. Hrdlička first directed attention to the very general and serious apprehension that the present war may have an untoward dysgenic effect on the race, saying that there exists, even among medical men and some men of science, a fear of the effect of shattered constitutions and the lasting results of shocks, strains,

exposure, and wounds, together with an acquisition of new diseases. "These assumptions," said the speaker, "are enough to make the pessimist despair of the future of the race, but happily these assumptions are not entirely correct. In the first place we have no scientific basis for the belief that any of the warlike nations of the past have actually degenerated physically as the result of wars. . . . . Unquestionably there are losses from every great war, and in these I include the debilitating effects of wounds and disease, but fortunately these appear to be only temporary."

"There are wonderful laws working on living nature, including humanity. One of these is the elimination of the unfit. Another is adaptation, still another is restitution, and finally there are the laws of compensation. These laws have taken care of war-ridden mankind in the past, and as they work with undiminished vigor they can safely be expected, with such intelligent assistance as can now be given, to accomplish still more in the future." Treating of the action of these laws, Dr. Hrdlička noted that many afflictions caused by the war are curable and others are not transmitted to progeny. The most dangerous diseases of previous wars have largely been eliminated by preventive means, while science is already coping with new conditions that have arisen.

The speaker then recounted some of the compensations that will arise from the war, chief among which he placed the impetus given to the struggle against alcoholism. Important also among the compensations will be the great intellectual stimulus, the social and national regeneration, and the raising of this nation from an isolated and somewhat selfish position to that of a world power in the best sense of the term and for the good of humanity.

In the discussion which followed this communication the office of the Surgeon General, U. S. A., was represented by Lieut. SIDNEY MORGAN, Sanitary Corps, U. S. N. A., who spoke on the surprisingly large percentage of wounded men who, by expert care, are returned to their homes fitted to be useful members of society.

Mr. FRANK D. TANSLEY, ex-president of the Patria Club of New York City, stated that the ratio of casualties in the present war is about the same as that in the Civil War, from which the nation has been able to recover. Mr. E. T. WILLIAMS, of the State Department, noted that there may be a deterioration of the race in time of peace, due to industrial conditions and crowding of factories. Dr. JOHN R. SWANTON contrasted imperialistic and emulative civilizations, to the advantage of the latter; Mr. JAMES MOONEY emphasized the thought that psychology is the dominant factor in race differentiation; and Dr. LEO J. FRACHTENBERG spoke of predominant elements in every race. Rev. JOHN M. COOPER mentioned an essential vitality which is the outcome of circumstance and which has been, to some extent, lacking in American youth but which may be developed by present conditions.

FRANCES DENSMORE, *Secretary.*

BIOLOGICAL SOCIETY OF WASHINGTON

The 576th regular and the 38th annual meeting of the Society was held at the Cosmos Club, Saturday, December 15, 1917; called to order by President HAY at 8 p.m.; 19 persons present.

The annual reports of officers and committees were received, followed by the election of officers for the year 1918. The results of the election are given herewith: *President*, J. N. ROSE; *Vice-presidents*, A. D. HOPKINS, H. M. SMITH, VERNON BAILEY, NED HOLLISTER; *Recording Secretary*, M. W. LYON, JR.; *Corresponding Secretary*, W. L. MCATEE; *Treasurer*, NED DEARBORN; *Members of Council*, J. W. GIDLEY, WILLIAM PALMER, ALEXANDER WETMORE, E. A. GOLDMAN, A. S. HITCHCOCK. President ROSE was nominated by the Society as a vice-president of the Washington Academy of Sciences.

President ROSE appointed as Committee on Publications for 1918: C. W. RICHMOND, N. DEARBORN, W. L. MCATEE, J. H. RILEY; as Committee on Communications: WILLIAM PALMER, ALEXANDER WETMORE, R. E. COKER, L. O. HOWARD, A. S. HITCHCOCK.

M. W. LYON, JR., *Recording Secretary.*

PHILOSOPHICAL SOCIETY OF WASHINGTON

The 793d meeting was held at the Cosmos Club October 27, 1917; President BUCKINGHAM in the chair; 27 persons present.

Messrs. J. T. TATE and P. D. FOOTE gave an illustrated paper on *Critical potentials for electrons in metallic vapors.* The subject matter presented was published in this JOURNAL (7: 517. 1917).

Discussion: The paper was discussed by Messrs. LOEB, SILSBEE, and BECKER.

By invitation Mr. S. J. CROOKER gave an illustrated paper on *Experiments on direct-current corona.* Electrical discharges in gases at pressures near that of the atmosphere may be divided into five classes: dark, glow, brush, spark, and arc discharges. Corona is a glow or brush discharge which appears on wires at high potentials indicating energy dissipation to the surrounding gas. Engineering experiments on the alternating-current corona have led to a revolution in the design and construction of high-potential transmission lines, machines, transformers, and insulators. Scientific investigations, especially on the direct-current corona, have led to an explanation of the phenomena observed.

A review was given of investigations made at the University of Illinois on the direct-current corona under various conditions. The corona discharge has been found to be a complicated function of the applied voltage; kind of gas and its pressure; size, shape, spacing, condition, and material of wires; temperature; humidity; etc.

The characteristic discharge is a uniform layer of glow for the positive wire and evenly spaced beads or brushes for the negative wire. The critical voltage increases with the radius of the wire and the gas pressure and is different for the positive and negative wires. A slight increase in pressure due to ionization occurs on sudden application of potential to

the wire and is a linear function of the energy applied for all gases. In hydrogen the critical voltages are much lower than in air and its characteristics are such that almost complete rectification of alternating currents is possible. When corona is present the potential distribution curves are much distorted from the theoretical position and indicate an accumulation of charges near the electrodes. Roughness or oxidation of the wire lowers the critical point and shifts the characteristic I–V curves. Different metals also show different characteristics.

A short series spark destroys the bead formation on the negative wire, produces divergent pencils, brushes or streamers on the positive wire, and reverses the position of the characteristic I–V curves. A special hot-lime-cathode Braun tube showed the currents through the spark and the gas to be unidirectional pulses.

The uniform positive glow is explained as ionization by collision of gas particles near the wire. The negative beads may be due to a combination of ionization by collision and electron discharge. The series spark impulses may cause a disruptive action in the surface of the wire shooting off high velocity positive ions which give rise to the positive streamers. The apparent destruction of the negative beads is probably a superimposed building up and decay of the observed negative discharge forms for each spark impulse.

Discussion: The paper was discussed by Messrs. AGNEW and L. J. BRIGGS.

The 794th meeting was held at the Cosmos Club November 10, 1917; President BUCKINGHAM in the chair; 38 persons present.

By invitation Mr. L. W. MCKEEHAN gave an illustrated paper on *Diffusion of, and recoil from, actinium emanation.* Previous work on the diffusion of actinium emanation and on the distribution of its active deposit between charged metal plates was reviewed, and the causes of some uncertainties in the interpretation of the results were pointed out. Apparatus was designed to avoid the defects thus discovered, and measurements made under a variety of conditions. The value of the diffusion coefficient of the emanation into air at the mean temperature of the experiments, 20.7°C., was found to be 0.109 (plus or minus 2 per cent). The distribution of the active deposit between positive and negative plates at different pressures agreed with that to be expected on the basis of radioactive recoil from the disintegrating emanation, and gave as the range of recoil in air at atmospheric pressure and at 20.7°C. the value 0.0092 cm. A closer theoretical study made it seem probable that the recoil paths are not straight, and preliminary work by the author and another, using C. T. R. Wilson's photographic method for studying the initial portions of α-ray trails, is now in progress.

Mr. N. E. DORSEY gave an illustrated paper on *Radium luminous materials.* No abstract.

Discussion: The paper was discussed by Messrs. BAUER and E. B. STEVENSON.

The 795th meeting was held at the Cosmos Club November 24, 1917; President BUCKINGHAM in the chair; 34 persons present.

Messrs. H. E. MERWIN and L. H. ADAMS gave a paper on *Polymorphism of the oxides of lead.* PbO appears in a red, tetragonal form stable below about 500°, and in a yellow, orthorhombic form stable at higher temperatures. Inversion with rising temperature is rapid, but with falling temperature so sluggish that it is the yellow form that is produced commercially from molten lead oxide. From hot solution in concentrated alkali both forms can be obtained. The yellow crystals frequently come out first and definitely orient the subsequent red crystals which are found attached to them. Pressure with a point upon certain faces of the yellow form causes immediate transformation to the red form at the point of pressure and along planes radiating in definite crystallographic directions. Pressure upon other faces causes cleavage, with little or no inversion. Heating causes the yellow crystals to become red before they begin to glow, owing to a large temperature coefficient of light absorption. In powder the red form is dull yellowish.

Discussion: The paper was discussed by Messrs. BUCKINGHAM, WHITE, SWANN, and BURGESS.

Messrs. G. W. MOREY and E. D. WILLIAMSON gave a paper on *Quantitative applications of the phase rule.* The subject of heterogeneous equilibrium is usually developed by the aid of the phase rule, together with the Le Chatelier principle of mobile equilibrium. The phase rule is a qualitative corollary of a perfectly general and widely applicable equation, equation 97 in Willard Gibb's paper "On the equilibrium of heterogeneous substances,"

$$vdp = \eta dt + m_1 d\mu_1 + m_2 d\mu_2 + \quad . \quad . \quad . \quad . \quad m_n d\mu_n$$

in which v, p, η, and t denote volume, pressure, entropy, and temperature, respectively; μ is defined as being $\left(\frac{\delta \epsilon}{\delta m_1}\right)_{v,\,\eta,\,m}$, ϵ being the energy, m_1 the mass of component 1, and the subscripts denote constancy of volume, entropy, and the other masses respectively.

The application of this equation to several problems was discussed. First, the method of derivation of the approximations known as the laws of dilute solutions was exemplified by the derivation of Raoult's law, stress being laid on the assumptions that it is necessary to make in order to derive these approximations from the exact relations. The application of equation 97 to some purely phase rule problems was then discussed. First, theorems were developed enabling the determination of the sequence of the P–T curves that intersect at an invariant point, then the question of the change in slope of the P-T curve of a univariant equilibrium with change in composition of phases of variable composition was discussed.

The subject matter of this paper has appeared in amplified form in the January number of the *Journal of the American Chemical Society.*

Discussion: The paper was discussed by Mr. SOSMAN.

DONALD H. SWEET, *Secretary.*

SCIENTIFIC NOTES AND NEWS

Dr. GEORGE E. HALE, Director of the Mount Wilson Solar Observatory of the Carnegie Institution, gave the public lecture at the annual meeting of the trustees of the Institution in Washington, on December 13, 1917. The subject of the lecture was "The development of the telescope and our expanding conception of the universe."

Prof. H. C. COWLES, of the University of Chicago, and Mr. E. W. SHAW, of the Geological Survey, spent two weeks of last October in Arkansas, continuing an investigation of the apparently fictitious "lakes" which have been shown on the maps of northeastern Arkansas for the past seventy-five years. Both the geological and the ecological evidence show that the lakes have had no real existence within a period of at least one hundred years. Their origin on the early land survey maps is still a mystery; later maps simply copied the "lakes" from the land maps or from one another. Messrs. COWLES and SHAW have devoted several weeks of each summer since 1913 to this investigation.

Mr. J. E. SPURR, formerly of the Geological Survey and for the past twelve years a consulting mining geologist in New York and Philadelphia, has returned to Washington and is residing at 1755 Park Road.

The Delegate of the Royal Swedish Government in the United States, Dr. HJALMAR LUNDBOHM, is well known to Washington geologists as the Director of the iron mines of Kiruna, Sweden, and author of papers on the geology of these ores. Dr. LUNDBOHM gave a talk on the Kiruna ores at the Petrologists' Club on December 18, 1917.

Representative S. D. FESS of Ohio re-introduced on December 11, 1917, the bill for a national university. The bill provides $500,000 for such a university for the fiscal years 1918 and 1919. The institution would be governed by a board of trustees in cooperation with an advisory council representing the states. It would confer no academic degrees and would accept only students of postgraduate standing.

The Patent Office Society of Washington has taken an active interest in the proposed Institute for the History of Science,[1] realizing the great aid obtainable from such an institution in the administration of the patent laws, as well as its general usefulness in aid of scientific investigation and the teaching of science. The Board of Managers of the Washington Academy of Sciences has voted its concurrence with the Patent Office Society in urging the location of the proposed Institute in Washington.

[1] See Science, N. S. 45: 284, 635. 1917.